Space Weather Technical Forecast

Issued on Wednesday, 26 October 2022 at 00:22 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Chance of Minor (R1) Radio Blackouts. Increasing chance of Active electron fluence. G1/Minor Geomagnetic Storms possible on day 3 (28 Oct).

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity over the past 24 hours has been Low, with two recent C-class flares from AR3133 in the northeast quadrant. This region has recently emerged across the limb. There are five sunspot regions on the visible disc. AR3126 has simplified with a loss of umbra in the leading spots. AR3130 retains some small intermediate spots with further emergence in recent hours. AR3131 in the northeast continues to develop with intermediate spots following a modest sized leader. AR3132 in the southwest is fading to become unipolar. AR3133 is bipolar and classified (Bxo/Beta). No Earth-directed CME's have been observed in available imagery.

Solar Wind / Geomagnetic Activity: The solar wind parameters, as observed by DSCOVR at L1, were indicative of a gradual exit from the High Speed Stream (HSS) of CH34/-. Solar wind speeds declined from slightly elevated at around 460 km/s to slow-ambient at around 380 km/s. Density was average or below. Total magnetic field strength was weak, with the north-south component, Bz, varying between positively weak and negatively weak. Phi angle was predominantly negative (towards the Sun). Geomagnetic activity was generally Quiet (Kp 0-2).

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) as measured at GOES-16 has remained at background levels. High energy electron flux (greater than 2MeV) at GOES-16 was at normal background levels. The associated 24-hour integrated fluence was well below the Active (1e8 integrated pfu) threshold, with an upward trend and a level of 2.18e6 integrated pfu observed at 25/2100UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is expected to be mainly Low with an increasing chance of M-class flares.

Solar Wind / Geomagnetic Activity: No Earth-directed coronal mass ejections have been observed. The Earth is expected to continue experiencing Low levels of solar wind Either later on day 2 (27 Oct) or during day 3 (28 Oct) the Earth is anticipated to connects with the high speed stream related to another coronal hole. Geomagnetic activity starting Quiet (Kp0-2) with isolated Unsettled (Kp3) intervals days 1 and 2 (26 and 27 Oct). By day 3 (28 Oct) there is an increasing chance of Active or Minor Storm (G1 intervals (Kp4-5), as the Earth connects with the high speed stream related to the next coronal hole CH36/+.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10MeV) is expected to be at background. High energy electron flux (greater than 2MeV) is expected to be mainly background to moderate levels at first, but is expected to trend towards higher levels

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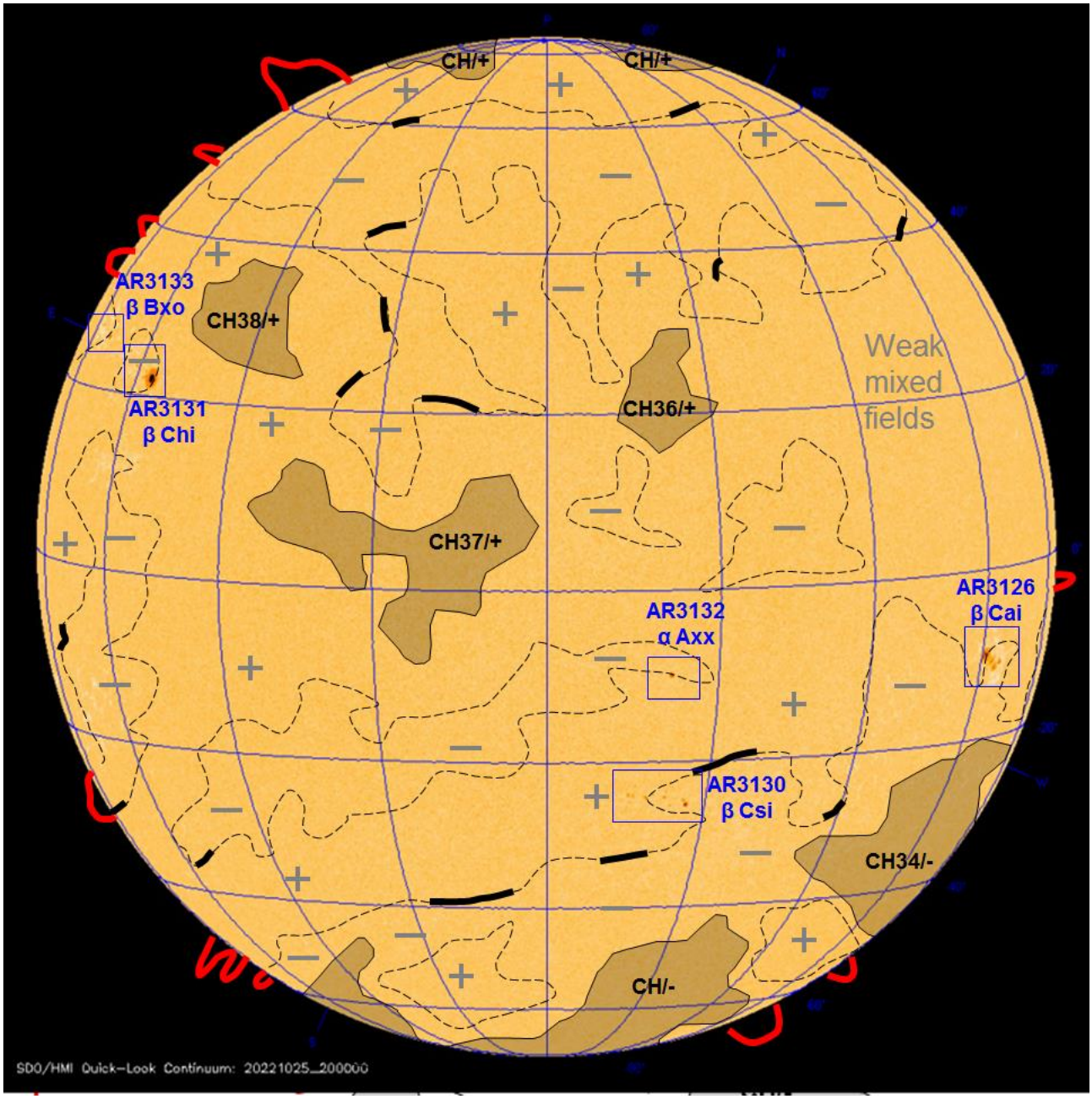
through 26 and 27 October as the high speed stream eases. Further reductions are then possible from 28 October due to a further high speed stream and resultant belt compression. Electron fluence values are forecast to continue trending upwards towards the Active threshold through the guidance period.

Figure 1. Solar Analysis Valid 2000 UTC, 25 October 2022.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

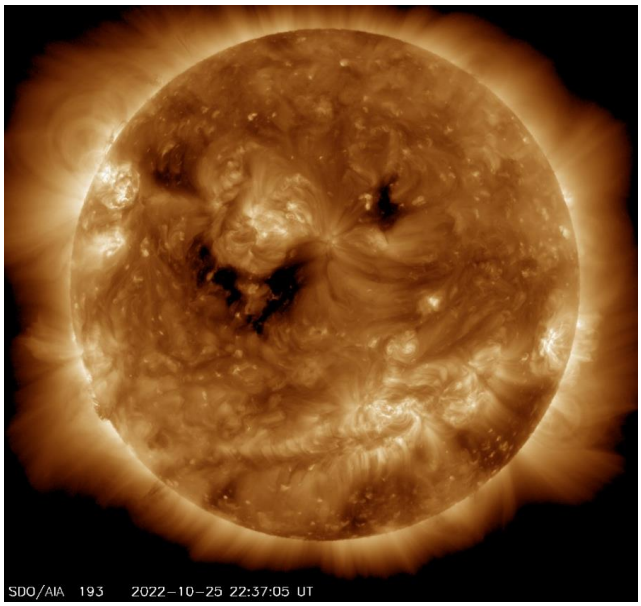
No Earth-directed CMEs are currently forecast.
The Earth is expected to continue exiting the HSS from CH34/- until day 2 (27 Oct), with slow-ambient solar winds declining a little further. An uptick in solar wind levels is forecast either later on day 2 (27 Oct) or during day 3 28 Oct) as the Earth connects with the HSS from CH36/+. On the last rotation this feature gave elevated levels reaching around 500-550 km/s, and in the absence of STEREO A data, similar speeds are forecast on this occasion. However the size of the hole on this current rotation appears a little smaller that could give lower solar wind levels. Connection to the high speed stream is forecast for either late on 27 October or more likely during 28 October.
Geomagnetic activity is expected to be mainly Quiet with isolated Unsettled intervals. By day 3 (8 Oct) there is a chance of Active or G1/Minor Storm intervals, as the Earth connects with the HSS of CH36/+, with this polarity favoured for stronger connections around the September equinox.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	10	30	10
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Nil.

Figure 2: AIA 211 imagery showing coronal hole intensity and locations.



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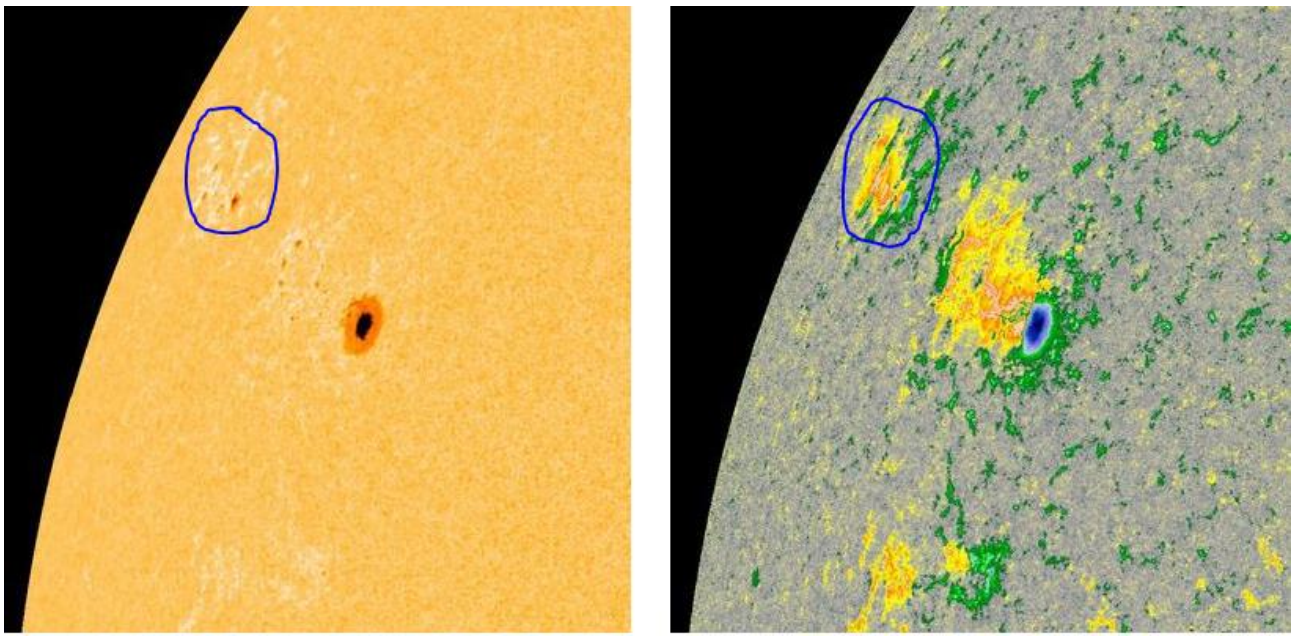
Radio Blackouts - X-Ray Flares:

Solar activity has been Low with five numbered sunspots on the visible disc. Most of the sunspots are of relatively small and benign in activity, with AR3133 the most active, with the recent C-class flare activity. AR3131 has rotated onto the northeast of the solar disc and despite an initially benign appearance, as a returning feature, enhanced activity is considered a possibility.

Low levels of solar activity with a daily 80% chance for C-class flares and an increasing chance (30-40%) of isolated M-class flares, mainly from AR3133 and perhaps also AR3131.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	30	30	40	30
Very Active	R3 to R5 X Class	No	1	1	1	1

Figure 3: SDO Intensitygram showing AR3133 at 25/2200 UTC, highlighted in blue pen, with AR3131 adjacent.



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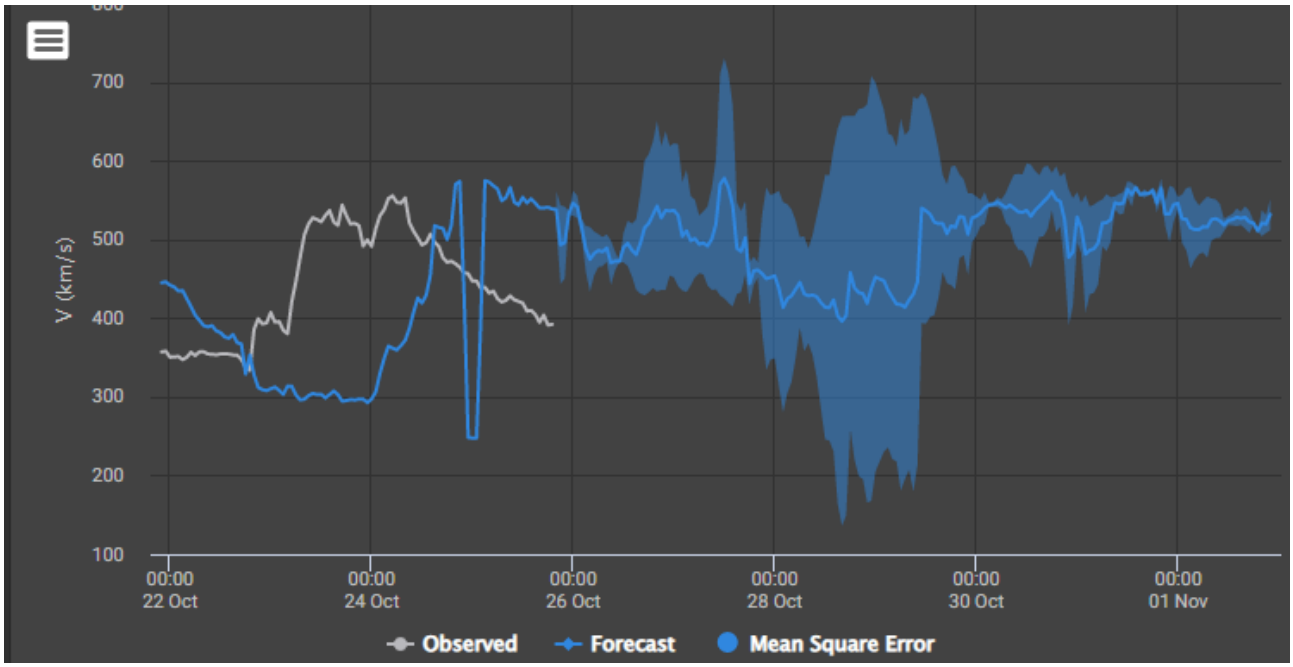
Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) as observed by GOES16 is currently at background and expected to stay at this level with no significant active regions on the visible disc.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	2	2	2	2
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Figure 4: Met Office Solar Winds Prediction Model (SWPM) for the next few days.



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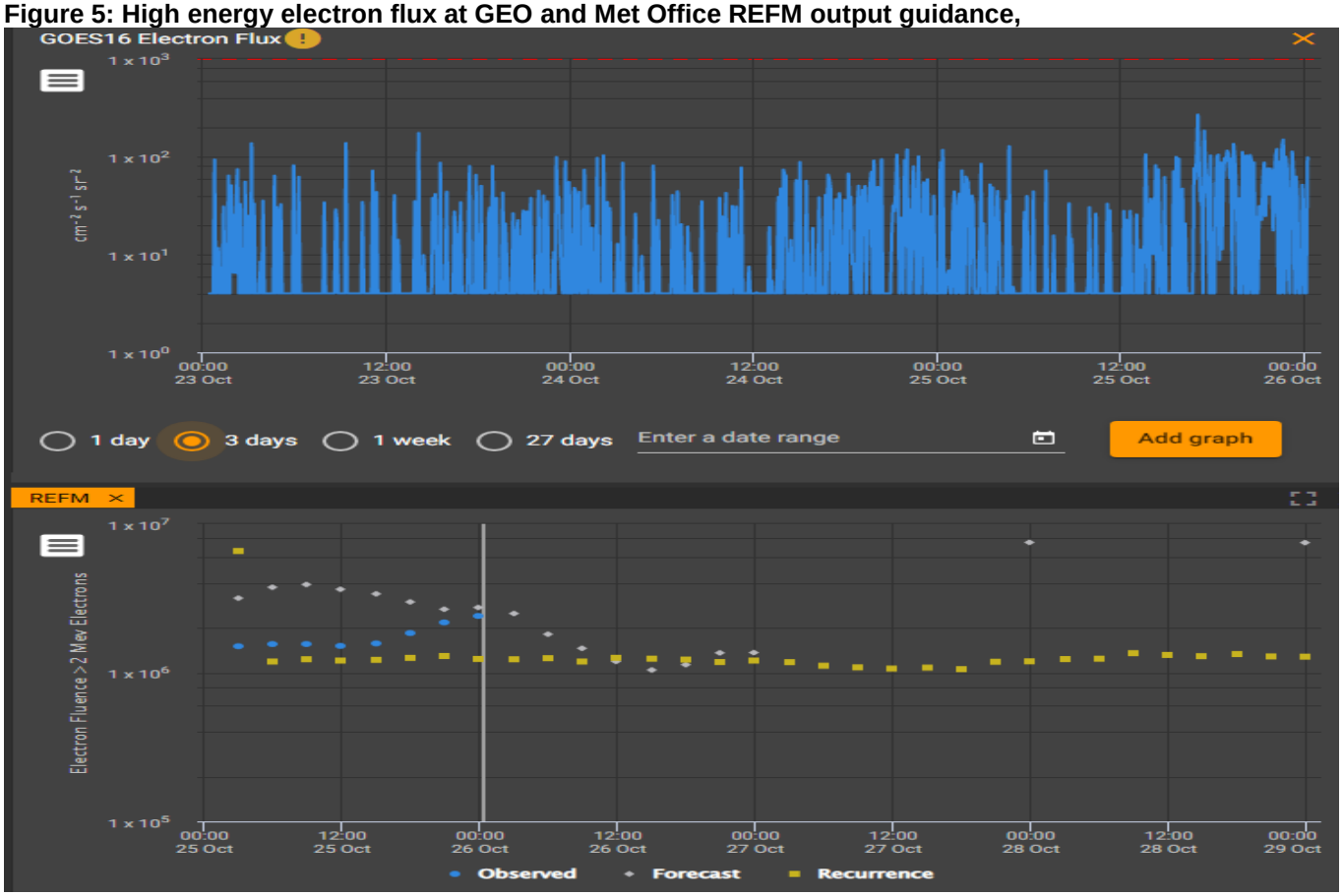
High Energy Electrons Event (≥ 2MeV):

The high energy electron flux (greater than 2MeV) has been close to background levels through the last 24 hours, likely due to the compression exerted on the radiation belts from the current high speed stream (HSS). This is likely to be compressing of the Van-Allen belts forcing high energy electrons out of their natural orbits, resulting in the measurements observed at GEO by the GOES-16 satellite. As the high speed stream continue to decline then electron flux levels are quite likely to move towards higher levels as the belts relax and electron inputs from the high speed stream become evident. The next HSS arriving by 28 October may then have a similar effect of distorting the radiation belts.

Electron fluence values are expected to continue on an upward trend in line with apparent increasing flux levels, with a trend towards the Active (1e8 integrated pfu) threshold towards the end of the forecast period, and this is reflected in the increasing probabilities in the guidance table above

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	20	40	30	50
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	2	5	5	5

Figure 5: High energy electron flux at GEO and Met Office REFM output guidance,



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